



THE

FRONTENAC
LEAD MINING COMPANY.
(CANADA.)

LIMITED LIABILITY.

CAPITAL, 200,000 DOLLARS (£40,000 STERLING).
IN 2,000 SHARES OF 100 DOLLARS (£20) EACH.

JAMES ROMANES, Esq.,
Kingston, Canada,
PROVISIONAL SECRETARY AND TREASURER.

Montreal:

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1888.

A correspondent at Kingston sends us the following account of the Frontenac Lead Mine (which has appeared in the Kingston News). It may be taken as a sequel to the article we before published of this mine, and shows steady and good progress:—

The work of development having been carried on all summer, there is now an opportunity to record the progress which has been effected in the intervening period.

This mine is situated in the township of Loughborough, and located on the Rouseborn lot; some twenty miles distant from Kingston by way of Railton, but the distance is shorter by the Perth road, though the latter road, in consequence of its bad state of repair, is not followed at the present season when the rains and fall weather have made its condition more than usually bad. In equipping the mine with suitable buildings, furnaces and machinery, a vast amount of teaming has had to be done. Most of the supplies have had to be conveyed from Kingston; and the necessity for good roads in getting in heavy machinery has fully impressed itself upon those who have had this important matter in charge. We make this remark in order to add that the County Council, in the view of meeting the wishes of the mining proprietors, and to aid in the prosperity of the township, have voted a sum of money to put the Perth road in repair.

In May last the work which had been done up to that time consisted in the erection of a substantial boarding-house, capable of lodging 30 men, the putting up of a blacksmith's shop, stable, driving-house, and powder magazine, the building of a house over the shaft, and an ore shed in which to store the ore.

The actual mining operations consisted in deepening the shaft over the vein (first begun by Mr. Rousehorn on his making the discovery) and in driving a tunnel or gallery in the vein itself, beginning at the lower part of the hill side near Indian Lake and pursuing an easterly course, intending to pass the site of the shaft and to continue the gallery on the other side of it. The gallery or adit is an important work, and the miners have been steadily engaged in it all the summer. When completed, it will drain the shaft and remove the water which percolates into the deep workings from the surface. It will enable the ore to be more readily got out by the practice of *stopping*, or by breaking down the roof of the tunnel. It is a slow and tedious work, but being preparatory to a more speedy process, it has to be patiently persisted in. The gallery has now been more than doubled in length, and in penetrating the hill side, has carried operations to a greater depth underground. All the ore that is got out is stored in the shed, awaiting the operation of the crushing and dressing machinery and the smelting process. In carrying on the preliminary operations thus far, it is computed that ore to the value of twenty thousand dollars has been got out. The work of tunnelling has more fully revealed the width and character of the vein. The fluted and columnar appearances on the wall rock, denoting a perpendicular movement and attrition, are held to be indications of great depth and permanence. The spar has proved richer in galena as the work has proceeded, and altogether the proprietors have met the encouragements to fortify themselves in incurring the heavy expenditure necessary to equip the works before they can expect to obtain any return.

The great labour of the summer, however, has been the erection of the crushing mill and smelting works, all embraced under one roof, in a capacious building of three floors, measuring sixty feet by six feet. This building has been erected, a steam boiler and engine of thirty-horse power by Messrs. Davidson and Doran, of the Kingston Foundry, has been put up, a brick chimney stack sixty feet high has been built, two smelting hearths have been put up and the place is being rapidly got ready for the crushing and washing machinery and the blowing fan intended to urge the heat of the smelting furnaces. The engine has already been started, and gave every satisfaction on trial. Massive spigot gearing and shafting intended to move the crushing rollers is also in place, and the entire apparatus might be soon in working order; but the season for washing is fast approaching its close, and the urgency for completing the machinery immediately is passing away. By spring, however, everything will be in readiness, though the company had hoped to be able to smelt the ore on hand this fall. In spring the work of stopping out the ore can be carried in the mine, when it will be procured in large quantity and at a rate adequate to keep the machinery regularly employed.

In laying out the reduction works advantage has been taken of the sloping ground to move the ore to its destination by the force of its own gravity. A tramway from the shaft leads to the upper story of the building, and the waste spar obtained in separating will pass out by a tramway leading to the place intended for its deposit, while the washed galena will be passed on to the floor beneath and conveyed to the smelting hearths. Everything promises to be exceedingly convenient. Nature has stood them service in supplying a head of water wherewith to wash the lead. A stream which empties into Indian Lake has been dammed up by a substantial structure, fitted with a sluice and flume, and the capacious pond formed will give an ample supply of water at the required height. The existence of this stream is an important subsidiary advantage to the mine.

In washing the ore the following process is employed:—The water is led to a tank which is covered or decked over, and in the covering floor of the tank are circular openings fitted with tapering flanged cylinders of iron, open at the bottom, and formed so as to contain a deep and stout sieve. Some six or more of these openings are arranged the top of the tank, and there is another opening fitted with a straight cylinder, in which an iron plunger about two feet in diameter is made to work up and down as if it were a force-pump. The stroke of the plunger causes a succession of waves or fluctuations to rise and fall in the sieve wherein the crushed ore is placed, and the effect of the movement is to cause the lead and spar to occupy two separate layers. The lighter spar from the uppermost layer is thrown out from time to time by an iron stick in the hand of the workman. The lead is of course retained and conveyed to the smelting furnace. Another variety of machinery called a buddle, which the lead is washed and separated by a circular motion, will also be employed.

PROSPECTUS

OF THE

FRONTENAC LEAD MINING COMPANY.

LIMITED LIABILITY.

CAPITAL, 200,000 DOLLARS (£40,000 STERLING).

IN 2000 SHARES OF 100 DOLLARS (£20) EACH.

The object of this Company is to carry on Lead Mining and Smelting operations, on the South Half of Lot No. 16 in the Ninth Concession of the Township of Loughborough (Canada), comprising about eighty acres. This property is situated fifteen miles north of the city of Kingston, to which Port there is communication by several roads.

The proprietors are possessed of the absolute mineral right, free from any rent or royalty whatsoever, for a period of twenty years from November, 1867,* and after that time (1887), in perpetuity, at their own option, for the nominal rent of four hundred dollars (£80 stg.) per annum.

The vein (No. 1) now being worked, and which is richly charged with galena, is twelve feet wide, runs north west and south east, and cuts the gneiss and crystalline limestone of the country at right angles. A shaft has been sunk to the depth of forty feet upon this vein, and an adit driven along it a distance of 150 feet into the hill. From these openings about

* A small area of 100 feet on the eastern boundary, traversed by vein No. 2, is held for a term of ten years under a royalty of 33 per cent of the gross yield, payable to the proprietors.

1400 tons of ore have been taken, up to the present time. The vein is free from silica, heavy spar, blende, or any other substance which would interfere with the easy mining, dressing or smelting of the ore.

For descriptions of the extent, value and capabilities of the mine, see the annexed reports.

The Capital of the Company is

200,000 DOLLARS (£40,000 STERLING.)

IN 2,000 SHARES OF 100 DOLLARS EACH, IF ALLOTTED IN AMERICA, AND £20 EACH, IF IN GREAT BRITAIN.

The proprietors retain 1,000 Shares, and offer 1,000 for sale, at par, 20 per cent. being payable on subscribing, and the remainder, in four instalments of 20 per cent. each, at 3, 6, 9 and 12 months. They will assign to the Company all their rights in the property (including buildings, supplies and plant, as well as all the ore upon the ground) as it stood on the first of June of this year; and undertake to procure the incorporation of the Company free of expense. All outlay incurred after that date in continuing the development of the mine, and in the erection of the works still required, (not, however, to exceed £ 2,000 stg.) will be advanced by the proprietors on account of the Company, and charged to the first earnings of the mine. Arrangements are being entered into, for the erection of a steam engine, together with the most modern and improved crushing, dressing and smelting apparatus.

It is proposed to commence smelting operations with American hearths, which have been found by experience, under similar circumstances, to work very satisfactorily. As illustrating what may be accomplished by using ordinary diligence, it may be mentioned that four small hearths will produce four tons of lead per day, and if work were carried on for only 200 days in the year, on a scale no larger than this, a very handsome profit would be realized.

KINGSTON, CANADA, 1st June, 1868.

REPORT,

BY E. J. CHAPMAN, PH.D., LL.D.,

*Consulting Mining Engineer, and Professor of Geology and Mineralogy
University College, Toronto.*

In association with Professor Bell of Kingston, whose intimate knowledge of the location rendered his co-operation most valuable, I have visited and carefully examined the mineral property of the Frontenac Lead Mining Company.

This property comprises the south half of Lot 16 in the 9th Concession of the Township of Loughboro', County of Frontenac, and contains about eighty acres.

In its surface aspect the location presents very favorable conditions for mining purposes. The southern portion consists of high ground, intersected by narrow valleys running in a general north and south direction, or parallel with the strike of the strata; whilst towards the north the high ground terminates in a more or less abrupt escarpment, the general trend of which is not far removed from east and west, its course being thus nearly at right angles to the direction of the valleys. North of the escarpment, the ground slopes gently towards a small sheet of water known as Indian Lake. By this outlet, water communication might be established, if thought desirable, with the Rideau Canal; but a more direct communication with the front is afforded by several roads, the distance from Kingston by one of these being under sixteen miles. This lake is not the only water supply upon the property. A small but unfailing stream flows through the principal valley of Lot 16, and empties itself into the lake. It can be made available at a very trifling expense, for washing and dressing the ore derived from the mine. It runs in close proximity to the mouth of an adit, now being driven on the property, and is within a few hundred feet of the principal shaft. A farther important feature as regards surface conditions, is the abundance of good timber present on the location. An inexhaustible supply for timbering the underground works is thus provided; and an abundant stock of fuel for smelting purposes can be obtained, at little cost, from the surrounding district.

The country rock of the location belongs essentially to the Laurentian or gneissoid series. It consists of alternate bands or strata of gray and reddish gneiss, interstratified with crystalline limestone. On one portion of

the property there is also an outcrop of sandstone, apparently belonging to the Potsdam division, which would answer, if necessary, for the outer portions and casings of furnace work, and for other building purposes. The Laurentian strata dip at an angle of from 80° to 85° , in a westerly direction, their strike being N. 20° E. The valleys or depressions, referred to above, have been excavated by denudation and atmospheric agencies in the surface of the limestone beds, and are usually marked by swampy land.

These various beds are cut transversely, or almost at right angles, by a series of parallel veins, running N. 65° W. The principal vein occurs just below the foot of the escarpment described above, and runs roughly parallel with this throughout the entire location. It appears, indeed, to extend far beyond these limits, but probably presents at no other part of its course so striking a development. It averages on Lot 16 at least 12 feet in width, and cuts the strata almost vertically, or with only a slight underlie towards the north. It consists, at this part of its course, of very pure and crystalline carbonate of lime, carrying workable quantities of galena, but without the slightest admixture of quartz, zinc blende, or other minerals which so frequently impair the quality of galena veins. The mineral galena is the ordinary ore from which almost all the lead of commerce is obtained. When pure and freed from gangue, it contains 86.6 per cent. of lead, and 13.4 per cent. of sulphur; but a portion of the lead is very generally replaced by a small amount of silver.

A shaft has been sunk and timbered on this vein to a depth of between six and seven fathoms, or nearly forty feet, and an adit level is being driven on the course of the lode from near the stream on Lot 16, to intersect the shaft. It will cut the latter at a vertical depth (from the mouth of the shaft) of about fifty feet. The present length of this adit is about twenty-five fathoms or 150 feet, but it is being rapidly increased. The adit is at too high a level to effect much beyond a surface drainage of the mine, but the nature of the ground renders this unavoidable. It will serve, however, effectually to intercept the flood water, resulting from the melting of snow, or from heavy rains, on the high ground: and it will also form a convenient channel for the outflow of the water pumped from the workings as the shaft progresses in depth, and stopping becomes regularly carried on. The present workings show no diminution in the width, richness or quality of the lode; and it may reasonably be inferred, from the great strength and continuous run of the vein, that these favorable conditions will hold good, if indeed they do not become more favorable, at greatly increased depths.

The extreme width of the vein makes the latter appear at first sight to be less rich in galena than is really the case. Here and there comparatively poor pieces of veinstone will of course occur; and, as pointed out to me by Professor Bell, the vein appears to be less rich where it cuts the red

gneiss, than where it traverses the grey rock : but in places some very rich stones of ore have been taken out of both the shaft and adit. Without operating on several tons of material, it would be difficult to form a correct estimate of the average amount of galena in the ore ; but careful examination of the heaps upon the ground, will warrant, I think, the assertion that at least one-tenth in bulk consists of galena. The miners on the spot, estimated the bulk of galena as varying from one-fifth to one-ninth of the mass. On the assumption that one-tenth, in volume, consists of galena, the latter would amount in weight to one-fourth of the ore, or 25 per cent. ; and the percentage of metallic lead would be equal to 21.35. The amount of ore obtained at the time of my visit (April 28th of this year) amounted to about 1300 tons. Allowing for the usual loss of lead in the mechanical and furnace treatment of the ore, and deducting the cost of the treatment by modern processes, the value of the ore (if reduced upon the ground) would amount to about \$11½ per ton, giving a value of nearly \$15,000 for that already brought to surface at the above period.

The vein possesses several conditions which add much to its value. In the first place it is composed of comparatively soft material, and is thus easily and cheaply worked. Secondly, its great width enables the miner to leave the hard wall-rock altogether untouched, more than sufficient space for working being found within the vein itself. Thirdly, the vein-stone contains neither quartz, zinc blende ("black Jack"), or other minerals, which so frequently interfere with the successful, or at least economic treatment of galena veins ; and, fourthly, the lead extracted from this ore, as found by my experiments, is of exceedingly good and pure quality.

I have made several assays of the galena, in order to determine the amount of silver contained in it. These assays show a mean amount of 4 oz. 12 dwts. 11 grs. per ton (2000 lbs) of reduced lead. This amount is scarcely sufficient to defray the cost of extraction in Canada, at least under existing circumstances ; but it will add to the value of the lead in the British market. Being also much in excess of the amount usually present in Canadian galenas, it may be found to increase at greater depths, or where the vein traverses the beds of crystalline limestone.

The following statement may serve to convey a more definite idea of the value of the Frontenac lode. Confining our estimate to that portion of Lot 16 on which the works are now being pushed forward, and to which, in all probability, they will be for some years restricted, we may regard the length of the lode within this area as equal to about 166 fathoms. The average width of the vein throughout this length is at least a couple of fathoms or twelve feet. Placing the drifts or galleries at ten fathoms apart, and assuming the specific gravity of the mixed ore to equal 3.7 only, the sloping ground between two drifts would give, on an average, 82,878 tons of ore. This amount, allowing fully for loss in treatment, should

yield at least 16,530 tons of lead. Putting the cost of obtaining this at \$7 per ton of ore (an estimate sufficient to cover every possible item), and assuming the value of lead in Canada to be \$80 (£16 stg.) per ton of 2000 lbs. (a price below the present value), the credit and debit account would stand thus :

Value of 16,530 tons of lead at \$80 per ton.....	\$1,322,400
Cost of mining and treating 82,678 tons of ore....	578,746
	<hr/>
	\$743,654

As it would be scarcely judicious to uncover the vein above the adit now being driven, the first drift or gallery would be placed at about 110 feet below the mouth of the shaft, the adit cutting the shaft at about fifty feet from the surface. If, consequently, the vein were to become altogether barren at that comparatively slight depth (a most improbable conjecture, it must be understood), a very large profit would be realized from that one portion of the mine alone.

The American hearth, giving a blast heated by the combustion of the ore and fuel, will probably be found the most suitable furnace for the reduction of the Frontenac ore, notwithstanding the loss of metal entailed by its adoption. Workmen acquainted with the proper management of this furnace can be readily obtained, and the process of reduction by its use is very simple, and cheaply carried out. Pine wood is chiefly employed as fuel, and very little is required, the heat being derived, to a great extent, from the combustion of the ore. An ordinary furnace of this kind will give from $3\frac{1}{2}$ to $3\frac{3}{4}$ tons of lead, at a cost of about \$2 per ton (or rather less) for fuel and labour, in each shift of 24 hours. Much of the ore may be rendered fit for furnace treatment by simple hand dressing, but the amount of galena saved by a more complete system of separation, would soon cover the cost of a crushing mill and washing apparatus. The proper site for the erection of these would, of course, be in the immediate vicinity of the stream on Lot 16, and a light tramway should connect the dressing ground with the mouth of the shaft. The shaft itself is already well housed; and a large shed for storing ore, together with a boarding house, blacksmith's shop, stable, and powder magazine, have also been put up for permanent use.

In conclusion, I may express my conscientious opinion that, under judicious superintendence and liberal management, the property of the Frontenac Lead Mining Company cannot fail to yield an ample return for the necessary outlay expended in its development.

EDWARD J. CHAPMAN.

Toronto, May 8th, 1868.

REPORT

BY CHARLES ROBB, Esq.,

Mining Engineer, and now in charge of the Geological Survey of New Brunswick.

96 ST. FRANÇOIS XAVIER STREET,
Montreal, 11th May, 1868.

To the Directors of the
FRONTENAC LEAD MINING COMPANY.

GENTLEMEN,

Having recently visited and inspected your very important and valuable Mining property in Loughborough, I beg now, in accordance with your request, to report, for your information, the following particulars with respect to it.

The boundaries and extent of the property, its main topographical features, the direction of the mineral veins, and condition of the enclosing rocks, are fully indicated by the accompanying plan.

The property is situated fifteen miles north of Kingston, at an elevation of about 300 feet above Lake Ontario; and is accessible by good roads, which, with the exception of two or three miles next the Mine, are macadamized. The natural outlet to a port of shipment is by the Rideau Canal; but for some time to come, it will probably be found most advantageous to ship from Kingston, to which city, ore can be teamed from the Mine for 2 dollars per ton.

The rocks by which this tract is underlaid, consist of alternating bands of grey and red Laurentian gneiss, interstratified with crystalline limestone, of the same geological age; and overlaid, at some points, by outlying patches of the inferior member of the lower Silurian formation—the Potsdam sandstone. In such geological position and mineral conditions, veins of galena, of greater or less importance, have been partially developed at several places in Canada, most of which have been visited by me; but nowhere, so far as I have observed, do they assume at all the same importance, both as regards size and richness, as on your property.

The strike, or general direction of the rocks, on your tract, is North 45° East, with a dip to West at an angle of about 75° . The course of the lead bearing veins, several of which have been discovered on your property, varies from North 55° West to North 65° West, thus constituting

ing true or fissure veins, cutting the rocks transversely and resulting from powerful and deep-seated disturbances and dislocations; hence they will undoubtedly prove persistent in depth to an indefinite extent. They belong, in fact, to, and probably constitute, the central, richest and most important section of the great group or system of lead-bearing lodes, which, following the general direction indicated, traverse the Laurentian rocks from Northern New York to Peterborough County in Canada; and have been more or less extensively developed at and near Rossie, New York, and in the townships of Lansdowne, Bedford, Storrington, Loughborough, Tudor, Lake, Methuen, and Galway in Ontario. Being thus persistent over such a great linear extent, there is every reason to believe that these veins will prove correspondingly so in depth.

On your property the principal vein, so far as yet established, is that which has been exposed and developed to a considerable extent by working, on Lot 16, in the 9th Concession. Here the outcrop of the vein was discovered on the northern flank of a hill overlooking a small lake (Indian Lake) and about 50 feet above the level of the water. A shaft has been sunk to the depth of 40 feet upon the vein, which is not less than $13\frac{1}{2}$ feet in thickness, exclusive of a selvage of from four to six feet thick, on the south side. The vein cuts the rock almost perpendicularly, but with a slight underlie to the north. The gangue of the vein is composed of a calcareous spar, without any admixture of quartz or other earthy mineral; and it is richly charged throughout with galena. No other metallic mineral is visible, except a very small portion of iron pyrites, in exceptional cases. The vein, as is usually the case in all powerful, true or fissure veins, has a banded or comb-like structure, consisting of alternating vertical layers of granular or compact and coarsely crystalline spar, with shoots of galena interposed throughout its entire thickness.

Towards the west, upon the course of the vein, the rocks at the surface have a natural declivity terminating in low ground, elevated not more than five or six feet above the lake, and about 50 yards from its bank. Here, a tunnel, or adit level, is now being excavated upon the course of the vein, which will cut the shaft at the depth of 45 feet from the surface. The length of this adit will be 54 fathoms, of which, at the time of my visit, 25 fathoms had been excavated, altogether from the lower side.

So far as yet opened up, the vein appears to preserve a remarkable uniformity, both in thickness and quality. The entire material of which it is composed will rank as lead ore, of which I estimate that 12,340 cubic feet have been already excavated and piled up. As nearly as I could ascertain by washing and dressing average samples, these piles of ore will contain about $12\frac{1}{2}$ per cent. of galena. Taking the specific gravity of the gangue at 2.5, and that of the galena at 7.5, the specific gravity of the entire vein matter will thus be 3.11, and the weight of a cubic foot

194.5 lbs., of which the proportion of galena will be $24\frac{1}{2}$ lbs. From these data the following inferences are deduced :—

1. One ton (of 2,000 lbs.) of the vein, contains ~~2.15~~ cubic feet.
2. One ton of galena is contained in 8.22 tons of vein matter.
3. One square fathom of vein, taken at 10 feet wide, will yield 4.38 tons galena.
4. One square fathom of vein contains galena equal to a solid plate of 6.23 inches thick.
5. The entire weight of vein-stuff excavated is about 1200 tons : and the contents in galena, 145 tons, which, being worth at the Mine about \$70 per ton, should realize over \$10,000, or more than six times the cost of extracting and rendering it marketable.

In continuation of the course of this great vein to the westward, the low ground extending to a considerable distance from the mouth of the tunnel, is underlaid by crystalline limestone ; and here, from the well-known affinity of lead to this description of rock, the vein, although unexplored, will probably be found to be even wider and richer than in the gneiss rock. In the opposite direction from the shaft (eastward), the vein has been traced to the boundary of this lot, a distance of 66 fathoms. The entire distance traversed by the vein upon this lot, and which may be calculated on with almost absolute certainty, is at least one third of a mile. So far as hitherto exposed, it certainly shews no falling off, but seems rather to improve in sinking ; and the nature of the ground is peculiarly well adapted for mining operations, and for the establishment of all the necessary works. For washing the ore, a stream which flows through the low ground, near the mouth of the adit, will afford throughout the year a supply of pure water, represented by a sectional area of about 150 square inches and with an ample fall, taken from a dam now in process of construction, a very short distance from the adit, between which point and the lake, the ground is very conveniently situated for the deposition of all waste materials from the crushing.

The vein being entirely free from quartz and from zinc blende, or other deleterious mineral ingredients, frequently associated with galena, can be mined, crushed and washed by the simplest and most inexpensive processes ; and it requires no further statements or calculations to make it abundantly obvious that this vein alone, both in extent, richness and the unusual facilities which it offers for working, is sufficiently important to justify a liberal outlay of capital in systematic mining, and in the erection of permanent and substantial machinery for draining the mine, and for crushing, dressing and smelting the ore.

From the compact nature of the vein and enclosing rocks, I do not apprehend that you will experience any unusual difficulty in regard to

drainage. Hitherto the miners have only had a little surface water to contend with, but on sinking below the water level, no doubt steam power will be required to drain the mine. Timber of all kinds requisite for fuel and for building and mining purposes abounds on your property, and in the immediate neighbourhood.

In the event of your erecting furnaces for smelting and reducing the ore, which is by far the most profitable form in which you can render it available, the beds of the Potsdam Sandstone, close to the site of such furnaces, will afford an ample supply of the best refractory material for the hearthstones and other parts of the furnaces, as well as for domestic purposes.

The following buildings, all of the best and most substantial description of framed work, are already erected on the premises :

Blacksmith's and Carpenter's Shop.....	31ft. x 26ft.
Carriage shed and 5 stall stable, with granary and hay loft.....	36ft. x 24ft.
Shaft house.....	18ft. x 16ft.
Powder Magazine.....	12ft. x 12ft.
Ore shed.....	48ft. x 24ft.
Boarding house.....	36ft. x 20ft.
with 2 stories and large attics, cellar, &c.	

In view of all the facts which I have above endeavored to detail, I can have no hesitation in urging upon you the propriety of pushing on your enterprise with the greatest energy and confidence, feeling assured that immediately on the erection of the requisite works for dressing and smelting, an ample and permanent return will be realized upon the capital invested.

I have the honour to be, Gentlemen,
Your most obedient servant,

CHARLES ROBB.

REPORT

ON THE FRONTENAC LEAD MINE.

BY DR. J. W. DAWSON, F.R.S., F.G.S., &c.,

Principal of McGill University, Montreal.

I visited the above mentioned mine on the 15th instant, in company with Dr. T. Sterry Hunt, F. R. S., of the Geological Survey of Canada, Prof. Bell, F. G. S., and Mr. Romanes, of Kingston; and now beg leave to make the following statements with reference to the results of my observations.

I.—Geographical and Geological Relations of the Deposits.

The mine is situated in the 9th Concession of Loughborough, Ontario, 15 miles north of Kingston, and on the border of a small lake, known as Indian Lake. The rock formation in which it occurs is the Lower Laurentian of Sir W. E. Logan's reports, consisting here of thick beds of silicious and felspathic gneiss, alternating with crystalline limestone. The beds of gneiss are nearly vertical, their dip being to the westward at angles of 80° to 85° . The strike of the beds is from N. 15° E. to N. 30° E. by compass. The gneiss constitutes ridges traversing the country in the direction of the strike of the beds, while the limestones form intervening depressions, as is usual in the Laurentian districts. Certain felspathic bands or masses in the limestones produce occasional slight elevations in the valleys occupied by the latter.

The lead veins belong to a series of transverse fissures, traversing the beds nearly at right angles to their strike, or with a direction of N. 60° W. These fissures, or the larger of them, constitute weaker places in the ridges of gneiss, and thus form notches or rows of "sink holes;" and in some places movements of displacement have occurred along the line of the veins, causing abrupt transverse escarpments, the downthrow being to the north.

The veins of this district are not local merely, but belong to a series of fissures, traversing extensively the Laurentian district of this part of Canada, and extending into St. Lawrence County, New York, where they have long been mined for lead. In the locality, now under consideration, they appear to be exceptionally large and productive.

II.—Nature of the Deposits.

The principal vein, which we may designate No. 1, is well seen in an adit, excavated in the course of the vein from the level of Indian Lake,

and in a shaft 500 feet distant, on ground elevated about 50 feet above the mouth of the adit; and also in some surface excavations on the crop of the vein.

It is a very large and regular fissure vein, with an underlie from the perpendicular of about 5° to the north. Its width varies from ten to fifteen feet. With the exception of a small quantity of greenish argillaceous rock, lining the south wall, the vein is filled with white crystalline calcareous spar, holding numerous crystalline aggregates of galena, or sulphide of lead, the most important ore of the metal. The only other minerals observed were small quantities of hydrous peroxide of iron (gossan) and of iron pyrites, and these are limited to the argillaceous band or "selvage," before mentioned. As in most large mineral veins, the vein-stone presents, especially near the walls, a series of parallel bands, produced by layers of calcareous spar and galena, and probably indicating successive periods of deposit. These bands are often so distinct that the vein-stone readily breaks with smooth surfaces along their planes of junction.

The part of this vein which may be regarded as proved, extends from the shore of Indian Lake about 650 feet to the eastward, in which space the ground rises in the course of the vein about 50 feet, and that to the south of the course of the vein much higher: the vein itself, as already mentioned, evidently constituting a line of downthrow to the north. Throughout this distance the vein retains the thickness and composition above stated, and its walls consist of greyish silicious gneiss.

Beyond the limit above stated, the vein No. 1 is not seen for about 400 yards, when it appears traversing a ridge of reddish feldspathic gneiss, and reduced to a thickness of about nine inches of spar, with little galena. This seeming failure of the vein is apparently connected with the occurrence of another large vein, which we may designate No. 2, about 100 yards to the north of the course of No. 1. In a shaft sunk on Lot No. 17, this second vein is seen to be eleven feet wide, and to contain calcareous spar similar to that of No. 1, but apparently holding less galena. Its strike, at the point where the shaft occurs, is $N. 54^{\circ} W.$, but, judging from other exposures, it varies somewhat in its direction.

In tracing vein No. 2 back to the westward, it is seen, near the boundary of lot No. 16, to turn, or give off a large branch running $N. 75^{\circ} W.$ toward vein No. 1, and here the galena again becomes abundant. This cross vein apparently connects at this place veins No. 1 and No. 2, and in my opinion, explains the dwindling of the former in proceeding to the eastward.

The supposed structure of this part of the deposit is shown in the annexed sketch map, the measurements of which have been taken from that prepared by Prof. Bell for the Company.

The veins have not yet been traced into the bands of crystalline limestone, lying on either side of the belt of gneiss above referred to. That they extend through these, is indicated by springs and accidental discoveries of galena in the soil, as well as by their appearance in the ridges beyond the limestone valleys. It will form a very interesting question in the exploration of the deposits, whether the veins, as is probable, improve in productiveness in passing through the limestone; and it would be desirable, as soon as possible, to ascertain whether this is the case. At present the elevation of the ridge of gneiss renders the vein more conspicuous and accessible than in the limestone; but when the mine becomes extended in depth, there will be no obstacle to prevent the following of the veins into the limestone, should they prove productive.

III.—*Openings on the Vein.*

The principal openings are the adit and shaft already mentioned.

The adit was, at the time of my visit, 155 feet in length, and was being pushed forward. It is 6 feet in width; and as the vein curves slightly, it exposes in one place the north, and in another the south wall of the vein, but in no place its whole thickness. The quality of the vein is apparently uniform throughout the length of the adit, and all the matter extracted from it is sufficiently rich for crushing, except a small quantity of barren calcareous spar, and a little gossan or yellow peroxide of iron. On the north wall the veinstone is in direct contact with the edges of the strata of gneiss; on the south wall, the "selvage" of greenish argillaceous matter already mentioned, appears, with small quantities of iron pyrites.

The shaft exposes a thickness of 10 feet 6 inches of the vein to a depth of forty feet. The whole of this thickness is calcareous spar with galena, without any other matter. The appearances are the same with those presented in the adit. It would appear that the total width of the vein at the bottom of the shaft is not less than 19 feet, of which 6 feet are occupied with the argillaceous matter already mentioned, leaving 13 feet of veinstone and ore.

The walls, as seen in the shaft, are similar to those in the adit, and there can be no doubt that the intervening portion of the vein, not yet opened, must be of the same dimensions and character. The shaft indicates that the vein widens somewhat in descending into the earth, and there is no indication that its quality becomes deteriorated. From the nature of the containing rocks, it may be safely inferred that it is continuous to a greater depth than mining excavations will ever reach.

There is no appearance in the shaft or adit of any faults affecting the vein. In the former the dip of the gneiss on the north wall, was seen, in one place, to change to N. 60° E., at an angle of 45°, without affecting the vein.

In both the adit and the shaft the gangue is more coarsely crystalline toward the centre of the vein, and more banded toward the walls, and the quantity of galena appears to be greater toward the sides, especially the north side; but the whole thickness is sufficiently rich to be profitably mined.

The quantity of water in the adit and shaft is not excessive or threatening; and from the texture of the rocks and veinstone, I should not anticipate any serious difficulty from this cause.

The above openings are on vein No. 1, which is evidently the most important for immediate mining operations.

IV.—*Quality of the Vein.*

The gangue in vein No. 1, is composed entirely of crystalline calcareous spar containing galena in crystalline grains and masses of various sizes.

Observing that the estimates of Prof. Chapman and Mr. Robb are somewhat different, as to the percentage of galena in the vein, we carefully examined the heaps of ore and veinstone taken from the shaft and adit, and amounting to a quantity estimated at 1300 tons, and agreed that the galena might amount to from one-fifth to one-sixth of the weight of the whole mass of the unsorted material; so that out of the comparatively small and superficial excavations above described, at least 213 tons of galena had been obtained.

In order more correctly to estimate the value of the ore, an average sample of about 70 pounds was carefully selected, and having been broken and divided into portions, one of these was carefully washed, under my inspection, and gave 16.5 per cent of pure galena.* I am confident that this proportion is not above the average produce which will be obtained on the large scale. It is equal to 330 lbs. of galena or 280.5 lbs. of lead, per ton of 2000 lbs. At the same rate, each cubic foot of the vein contains 25.7 lbs. of galena; each cubic fathom, 2.77 tons; and each square fathom of the vein, estimated at 10 feet thick, which is below the average width, 4.62 tons. At the rate of \$70 per ton of galena, each cubic fathom of the vein is worth \$193.90.

Taking the actually proved portion of the vein at 600 feet in length, and supposing this portion to be worked by means of the shaft already in progress, and by levels at 60 feet apart, the space between two such levels or between the floor of the present adit and the first level, would afford 4,400 tons of galena, worth \$308,000, without, as far as present appearances show, a yard of unproductive working. It is probable that the depth to which such working could be carried would be limited merely

* Dr. T. Sterry Hunt, F.R.S., of the Geological Survey of Canada, writing from Montreal, under date 9th May, 1868, says: "I have found my portion of the sample from the Frontenac Lead Vein, to contain, as near as may be, 16 per cent. of galena, which agrees closely with Dr. Dawson."

by the mechanical difficulties of deep mining; and no account is taken of the almost certain productive continuation of the vein to the east and west of the limits above mentioned.

With reference to the value and productiveness of the mine, the following conclusions may safely be drawn from the facts above stated:—

1. The Frontenac Lead Mine, as now opened on vein No. 1, has exposed a deposit of remarkable richness and extent, warranting the erection of all necessary machinery for crushing, washing and smelting, with a certainty of very large profits, under management ordinarily skilful.

2. The further extension of this and its companion vein, on the property of the Company, is of undoubted value, and points to an almost indefinite future development of the mine.

3. The gangue of the vein is of such a character as to be easily mined, crushed, and washed from the ore, being free from hard substances, such as quartz, which would damage mining tools, or render the crushing more difficult, and from heavy minerals, such as barytes, which would interfere with the washing. The ore is also remarkably free from those other metallic minerals, as blende, pyrites, &c., which often occur with galena, and impede its reduction, or affect the quality of the lead. For these reasons no difficulties need be apprehended in the treatment of the ore, and the whole working of the deposit should be of a simple and inexpensive character.

4. Calculations of the probable profits of the mine may be safely based on the above estimate of 330 lbs. of galena per ton of veinstone; or 4.62 tons per running fathom.

V.—*General Remarks and Recommendations.*

The estimates made by Dr. Hunt and myself, as to the proportion of lead present, are intermediate between those of Prof. Chapman and Mr. Robb; and I fully agree with both of these gentlemen as to the great value of the property, and also in advising that advantage should be taken in the exploration of the deposit, of the experience gained in similar works in the United States. More especially, as the vein is very similar in character to those worked at Rossie, New York, though of larger dimensions, the methods in use there, in so far as they are good in themselves, would be found suitable to the Frontenac Mine.

The present workings and the buildings of the Mine appear to me to be judiciously planned and situated, and no wasteful expenditure seems to have been incurred. The stream which feeds Indian Lake will afford the water required for washing the ore. Wood for fuel and other purposes can be obtained very cheaply, and there will be no difficulty in shipping the produce of the Mine from Kingston.

The present works and the portion of vein No. 1 already proved, should be made the basis of operations ; and even if the deposit should prove richer in the limestone, the present site will be found sufficiently suited for working this extension, and also for collecting the produce of such smaller workings as may be made to prove the deposit east and west.

The only portion of the mine that can be worked without pumping is that above the level of Indian Lake ; but though this contains a considerable quantity of valuable ore, it should, I think, be left in the meantime, and pumping machinery should be erected sufficient to free the mine from any probable quantity of water, while all possible precautions should be taken to prevent the entrance of surface water from the outcrop of the vein.

The property now in possession of the Company, appears to contain all the more valuable deposits, and to be sufficiently extensive.

The percentage of silver found by Prof. Chapman in the ore, though for the present not deserving of entering into the calculation of the Company, points to the importance, when the mine shall be more fully opened, of making trials of samples taken from the different veins in different parts of their extension longitudinally, and also in their depth and width, since it is quite possible that the silver may be accumulated in certain portions of the produce of the veins, in such a manner as to make a separate extraction with reference to it, profitable.

I had not an opportunity to visit the outlier of Potsdam sandstone in the vicinity of the mine, referred to in Prof. Chapman's Report. It will, without doubt, be of considerable value to the Mine as affording the materials of furnaces, &c.

It is possible that when excavations are made in the limestone valley on the course of the veins, quantities of alluvial or stream lead ore may be found to have accumulated from the waste of the outcrops of the veins.

In conclusion, I would repeat the opinion expressed above, that the deposit is of unquestionable richness and value, and free, in so far as can be observed, of any circumstances of a prejudicial character. I may add that it is, in so far as I know, by much the most important deposit of lead hitherto found in Canada, or in the neighbouring parts of the United States.

J. W. DAWSON.

Montreal, 27th May, 1868.

REPORT,

BY CAPTAIN McDONALD,

Late General Manager of the Rossie Lead Mines, State of New York.

EDWARDSVILLE, ST. LAWRENCE COUNTY, N. Y.,

May 18th, 1868.

To the Directors of the

FRONTENAC LEAD MINING COMPANY,

GENTLEMEN,

I visited the Frontenac Lead Mine about five weeks since, and was highly gratified with the promising appearance of the vein. The shaft at that time had attained a depth of about 33 feet. The vein at this depth is apparently of the same width as at the surface, varying from ten to twelve feet, and highly charged with mineral.

The drift or level, which is being driven east on the vein, had then gone in about one hundred and thirty feet with very satisfactory results. The vein is apparently as large at this point as it is in the shaft, and has lead disseminated through it in considerable abundance.

The ore is remarkably free from any association with copper pyrites or mundic, differing in this respect from all the lead veins of Rossie, New York. With the mine fairly developed and with an amount of machinery (such as hoisting, crushing, dressing, and smelting power) adequate to the requirements, the success of the mine cannot be otherwise than permanently established.

Respectfully Yours,

A. McDONALD.

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REPORT

BY CAPTAIN PLUMMER,

Of the Bruce and Wellington Mines.

The following extracts from the report furnished to the Directors by Captain William Plummer, of the Bruce and Wellington Mines, on the practical and economical working of the Frontenac Mine, may prove of interest.

WEST CANADA MINE,
Lake Huron, Ont.,
June 20th, 1868.

To the Directors of the

FRONTENAC LEAD MINE.

GENTLEMEN,

I have visited and inspected your mining property situated in the Township of Loughborough, in the County of Frontenac, Ont., and beg to hand you the following report thereon:

I would here premise that, as the property has been reported on by others, who have gone fully into its situation and extent, the topographical features and its geological characters, it will be unnecessary for me to refer to these points, any further than they bear upon the economical working of the Mine.

The situation of the property presents many favourable conditions. The configuration of the ground consists of high ridges and valleys, and although it presents a rugged appearance, its broken nature affords increased facilities for carrying on mining works, in the discharge of the stuff from the shaft, affording good sites for the construction of dressing machinery, and natural slopes for washing the ore, rendering unnecessary deep and expensive cuttings and removal of the soil, which are found to be serious charges, in most cases, upon the funds of new mines. There is an unfailing stream of water, equal to the wants of the washing department, running through the location, quite close to the point where it is required, which,

by the construction of an inexpensive dam at the place I pointed out, can be raised to a level sufficiently high for this purpose. There is also a good supply of timber at hand for mining purposes, and for smelting the ore on the spot. A good road, which is nearly completed, brings you within easy distance of a port of shipment for the produce of your mines, when converted into *metal*.

The "country rock" on the property belongs to the Laurentian series, and consists of belts of grey and white gneiss, or quartzite, with bands of limestone. The rock is regularly stratified, and dips in a westerly direction, having a strike or bearing North of East. A series of parallel veins are discovered cutting transversely through the strata. The one on which mining operations are presently carried on is found where a break occurs in the formation, near 'Indian lake,' and can be followed eastwardly by the numerous depressions on its course, where not otherwise exposed, for upwards of a mile.

On lot 16, where the principal workings are, the vein averages 12 feet wide, and contains, in a gangue of pure crystalline carbonate of lime, (calc-spar,) a considerable quantity of galena disseminated through it.

Near this point a shaft has been sunk some thirty feet deep, and has developed a vein of galena such as is rarely seen near the surface. * * The vein in the adit is precisely of the same character as in the shaft, and appears to be equally wide and rich. * * * I may here remark, that I had opportunities of knowing the percentage of galena, found by calculation of the three gentlemen who have reported on the property, and I am inclined to think that that of Mr. Robb will be found to contain as much as will be recovered by mechanical or furnace treatment, and this amount, 12 per cent., must be considered rich, when compared with the lead mines in this or other countries.

Such a vein as this, when brought into practical operation, will afford handsome profits to the Stockholders.

The vein can be traced eastwardly for a considerable distance through the property, by numerous depressions on the surface where the substances of the vein have decomposed, and at every point where openings have been made, it shows it to be one of those "*Master Lodes*" practically without limit as to its depth or length. * * * There are several veins of precisely the same character as the one described, but they have not yet been traced into the ore-bearing bands of gneiss, but there can be no doubt, when they are opened on the same rock, that they will be found equally as valuable.

There are several circumstances connected with these veins which add greatly to their value.

First, the soft and friable nature of the rock renders it easy for cutting. Secondly, its great width lessens materially the cost per ton for mining

charges. A narrow and contracted vein often costs more per fathom than a wide and rich one.

Thirdly, the gangue it contains is easily reduced and removed by mechanical treatment. I have never before seen a vein so free from deleterious matters. There is no blend, or sulphuret of iron, or baryta, which, so common in lead mines, renders the mechanical treatment of the galena so extremely difficult and expensive; and by the high specific gravities of the associated minerals, lessens, to a great extent, the yield of galena.

I have great faith that other points on the line of the vein will be found equally as rich as that on which the shaft is now being sunk. * * *

The character of the formation, and the extremely well defined and persistent vein, shows it to be one of unquestionable value, and the future development of this, as well as the other parallel lodes on the property of the Company, points to a prosperous future of almost indefinite extent.

I am, Gentlemen,

Your obedient servant,

WILLIAM PLUMMER,

Manager of Mines.